UNIVERSITÀ DEGLI STUDI
DI MILANO

Master Degree in Computer Science

Image Processing

academic year 2013–2014 Teacher: Stefano Ferrari

Written exam example

scores **1** (2) _____ **2** (3) _____ **3** (3) _____ **4** (4) _____ **5** (4) _____ **6** (4) _____

Surname_____ **Name** _____

Matriculation number_____ **Signature** _____

Question 1

Using the 8-adjacency relation, identify in the bitmap (where 0 is the background):

(a) the pixels that are adjacent to the pixel α;

(b) the shortest path connecting the pixel α to the pixel β;

(c) the connected regions.

0	1	0	1	0	1	1
1	1	1	1	0	0	1
0	0	1^{β}	1	1	0	1
0	0	0	0	1	0	0
0	1	1	0	1	1^{α}	1
1	1	0	0	0	1	1
1	1	1	1	0	1	1

(a)

0	1	0	1	0	1	1
1	1	1	1	0	0	1
0	0	1^{β}	1	1	0	1
0	0	0	0	1	0	0
0	1	1	0	1	1^{α}	1
1	1	0	0	0	1	1
1	1	1	1	0	1	1

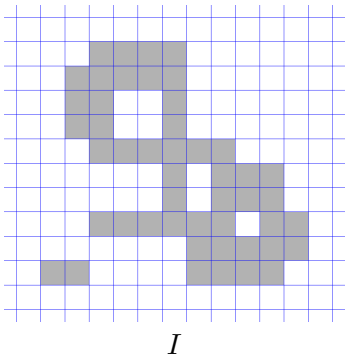
(b)

0	1	0	1	0	1	1
1	1	1	1	0	0	1
0	0	1^{β}	1	1	0	1
0	0	0	0	1	0	0
0	1	1	0	1	1^{α}	1
1	1	0	0	0	1	1
1	1	1	1	0	1	1

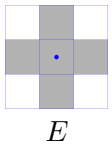
(c)

Question 2

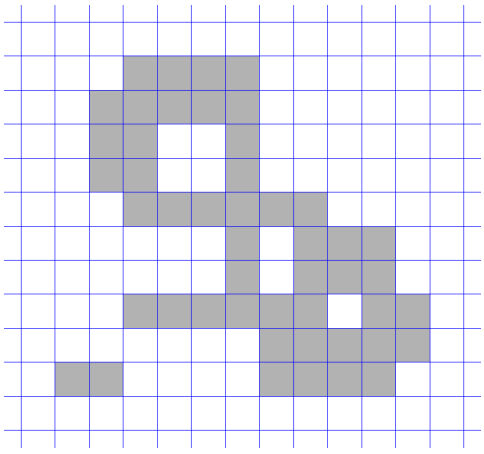
Compute the closing of the image I operated by the structuring element E.



I



E



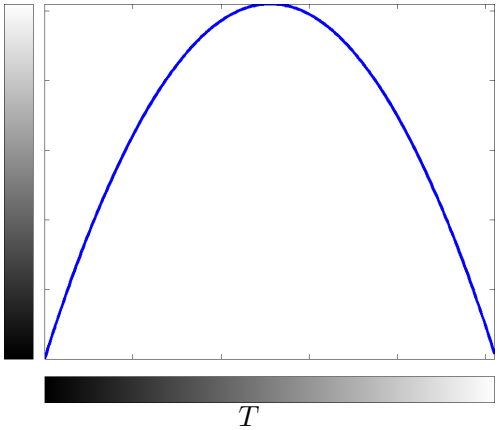
Question 3

Given the image I and the transformation T, indicate (justifying the choice):

(a) which among the following images is $T(I)$;

(b) which among the following histograms corresponds to I.

I

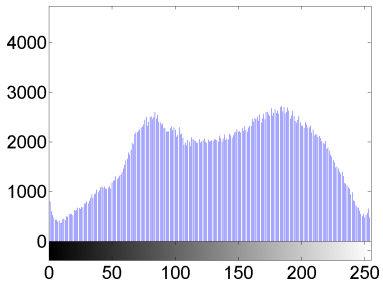


T

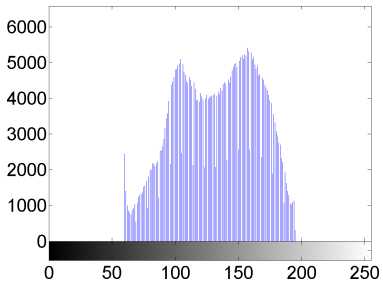
(a)

(1) (2) (3) (4)

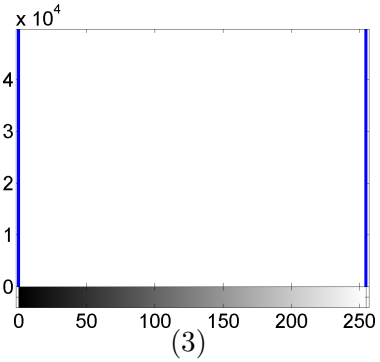
(b)



(1)



(2)



(3)

Question 4

Histogram based intensity transformations.

Describe the fundamental concepts and the applications of these techniques.

Question 5

Spatial domain filtering techniques.

Describe the motivations for the use of these techniques and summarize an overview of the approaches belonging to this field.

Question 6

Design a QR code acquisition system.

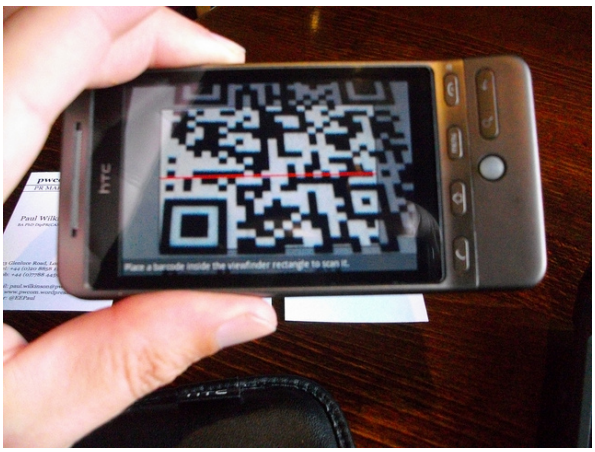


Photo by Paul Wilkinson

Photo by Individual Design

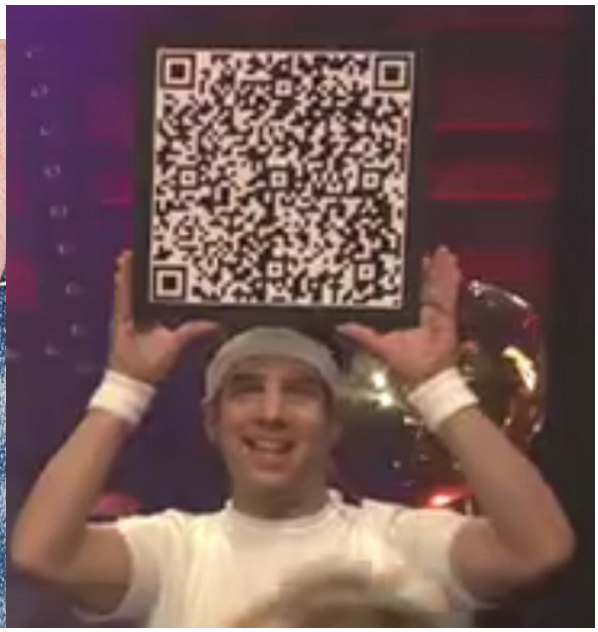


Photo by Elizabeth Thomsen

A project is aimed at implementing a system for detecting the region representing the bidimensional barcode inside the image.

The QR codes are binary bidimensional matrices used for coding short textual strings o numerical sequences. The coding syntax is such that the message can be easily decoded and the coding is robust to perspective transformations.

The use of enriching messages with QR-code have spread with the diffusion of smartphones. Typically, the mobile devices are equipped with an application for QR-codes decoding. The user frames the QR-code and the application detects, acquires, normalize, and decodes it.

Among the components of the present project, only the QR-code detection module have to be considered.

Point out the techniques that can be used for obtaining the required data, explaining the motivations for those choices.